Aspen Reels Protective Case

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Abstract:

Barrel Service Company, a southern California machine shop, is looking to start making machined aluminum fly-fishing reels. There is a well-established market for this product and Barrel's offering, the Aspen RE-1046, is intended to break into the low- and mid-range segments. While the product and process development work is being done in-house and progressing steadily, the company has a need to improve its packaging of the product. The solution outlined in this report is a durable, reusable case that is intended to be used by the end user for years after the product has been purchased. This package is therefore a product in itself, and is intended to add value to the client's product and potentially even provide opportunities for a spinoff.

Acknowledgements:

We would like to thank our technical advisor William Bramble and Barrel Service Company who started the Aspens Fly Reels product line. Other important people and companies include Rick Flamson of Rick's Sport Center and John Pillow at Four Season's Outfitter's.

List of Tables:

List of Figures:

Table of contents:

Introduction:

Problem Statement

Aspen Reels is the name of a line of fly fishing reels about to be released by a small machine shop in Southern California. The RE-1046 will be targeted to budget-minded individuals who still want a high-quality reel. The company is in the advanced stages of development and needs work in a few key areas which include packaging innovation, distribution channels, and product development. Improvements in these areas will help the company grow and expand into the market. The company is capable of performing the product and process development work in-house, and the distribution channels will mainly consist of small shops across the state, so this project focused on providing a unique package for the product.

Needs

Provide the client with a viable, attractive, and efficient packaging product. The client's customers would look for the following:

Table 1 – Client needs rating

Needs	Scale (1-4)
Attractive	4
Affordable	3
Protective	4
Convenient	3
Rugged	3
Sustainable	3.5
Quality	4

Background or Related Work

There are various fly fishing reel packages out on the market, from mass-produced cheap packages to custom one-of-a-kind packages. Currently Aspen Reels uses a zippered pouch lined with cushion material within a corrugated shipper. As per our discussions with the owners of a couple fly shops, this is the norm for fly reels across the board. Even premium brands, such as Galvan and Orvis, use a similar package, while some of the cheaper brands encase the reel in a heat-sealed plastic bag. With the multitude of fly fishing reels out in the market today, our goal was to develop a package that stands out from the rest of the competition.

Potential Solutions

We explored a couple of different ways of approaching the problem of packaging this product. The first was to update the company's existing package with new graphics and literature, as the current package is plain and uses a sticker-applied label and very basic literature. The second was to design and prototype a higher-quality case for the reel that would store the product safely and attractively, but was not intended to be used in the field. The third option was to design and prototype a durable case that could be used to transport the reel through rough conditions in a backwoods environment until it was ready to be put on a rod. This project focuses on the third option; a durable case that will do much more than simply contain the product. We focus on this last option primarily because no other companies, through research, have developed a hard protective case. Currently on the market the closest protective cases are made for basic storage. This includes wood boxes, soft leather pouches, and neoprene bags. We feel going this route could potentially be a viable solution.

Contribution

This project contributes a service (packaging development) that is not feasible for the company to perform. With a small business, some areas, like packaging, fall to the bottom of the priority list and therefore need improvement. This project has potential to increase the value of the product and increase the sales for the company. The most important contribution is the product protection; the fly reel will be well protected during its everyday usage.

Scope of Project

We would like to deliver a physical prototype package that the company will find useful and plausible for future use. The prototype will be accompanied by this report, which details the process used to design the product and the steps necessary to potentially implement it into production.

Background Search:

Fly-fishing industry information

Fly fishing as a sport and hobby has been around for more than a century and is practiced all over the world. Thousands of people enjoy fly-fishing as a means of recreation and relaxation. Every two years, Leisure Trends Group conducts a retail study entitled “The Fly-Fishing Market in the United States” and makes it available to members of the American Fly-Fishing Trade Association (AFFTA). Fortunately, our client in this project is a member of this trade association and so we had access to the information in this report. In order to gain a more accurate picture of the characteristics associated with the fly reel market, we looked at such information as total reel sales, brand penetration, price points, and sales distribution by retailer type. The survey has been conducted biannually since 1998, giving this 2007 iteration the ability to compare its values against five previous surveys.

The survey found the total retail sales of the 2007 season to be $804.8 million. Of this total, $657.9 million was conducted by what it calls “historical core” operations, and $146.9 million was accounted for by national outdoor chains. The report defines “historical core” operations as being made up of the retailers that traditionally form the core of fly-fishing retail sales: single- and multiple-location specialty fly shops, independent sporting goods stores, and sporting goods chains. More recently, mail-order and internet-based operations have been included in this category, though their contribution is relatively small. This 2007 study is only the second one to include the nationwide outdoor chains, and still does not include sales through mass merchants such as WalMart and Kmart and department stores. Of these total sales, the greatest amount was contributed by retail operations in the Rockies, with 37.8%, and the West, with 25.3%, both of which grew from previous years. Overall, despite growth in the Rockies and the West, retailers considered the 2007 season flat compared to the 2006 season. It is also interesting to note that 55.6%, or $365.5 million, was conducted through single-location specialty shops, proving the small local shop to still be the backbone of the fly-fishing retail industry.

Reel sales, in terms of dollars, went up 2.7% from 2006 for a total of $75.7 million. This total places reels behind only flies ($107 million) and rods ($100.7 million). Nearly every other product category, with the exception of fly rods, declined by at least the same amount. Fly reels accounted for 11.5% of historical core retail sales in 2007. Ross Reels, whose products are discussed later in this report, led brand penetration in 2007, with 41.4% of retailers carrying its reels, and was also named by a majority of retailers as their best seller in both sales dollars and units sold. As might be anticipated given the fact that most sales are conducted through single-location specialty shops, most retailers do not sell very many reels per year. The majority (73.6%) sold less than 100 reels in 2007, with the mean ending up at 99 reels per year. Independent sporting goods stores were the lowest, with an average of 73 reels per year, then single-location specialty shops with 112, and finally multiple-location shops selling an average of 150 reels per year. Only 11% of all historical core retailers sold more than 200 reels in 2007. Aspen Reels' pricing strategy appears to be justified given the finding that 59.7% of reels sold in 2007 were priced less than $175. Independent sporting goods stores, especially, were likely to have sold high quantities of reels under $175. This trend continued in the national outdoor chains, with 63.3% of reels sold being under $175. Reels in general made up 12% of those chains' fly-fishing retail sales, for a total of $17.6 million.

As of 2007, fly-fishing reels appeared to be about a $93 million per year market, of which about $56 million was contributed by reels under $175. The market also showed growth in the two westernmost regions and the national outdoor chains reported general growth over previous years. In terms of product mix, the fly reel market is relatively saturated, but this study shows that customers have a propensity to buy reels in the lower end of the price range, and Aspen Reels intends to offer a superior product in that range and capture some of that market share.

A search of the United States Patent and Trademark Office reveals several patents related to fly-fishing equipment. Many of them are older and many of them are cases designed to fit a rod and reel combination together. There are also many patents concerning the operating mechanism of the fly reels themselves. The implications of this search on this project were minimal, as even though intellectual property concerning fly fishing equipment exists, it does not appear to encroach upon the direction this project will take.

Talking to fly-fishing professionals was one of the most important aspects of our search for background information on the fly reel market. Fly-fishing shops are an obvious first place to start looking for such professionals.

Rick’s Sport Center is a sporting goods shop in Mammoth Lakes, CA, well-positioned in the Eastern Sierra trout fly-fishing arena. The store is primarily a fishing store, though it does provide a range of products and services. Rick’s provides a guide service, and employs several competent guides. These guides, as well as several of their friends, have all tried the Aspen reel. Their reviews of it were for the most part positive. They like the functionality of the large drag knob, though feel that its size might detract aesthetically from the product. There is a scraping in the prototype model that will need to be eliminated before the product goes into full production, and the guys at Rick’s also commented that the reel could always be lighter. One of the points that Rick himself emphasized is that the reel must be offered to the customers at a low price, preferably $150 or under. As far as packaging, we learned from Rick’s that most, if not all, reels come in a standard corrugate box with some type of additional internal packaging, such as a plastic bag, neoprene case, or silk bag. Most of these boxes are not extremely colorful and are not visually exciting. We learned from Rick’s that there are some small wholesale distributors for fly fishing equipment, but for the most part the shop deals directly with manufacturers.

Four Season’s Outfitter’s is a local sporting goods store in San Luis Obispo. This store focuses more on hunting and shooting supplies than fly-fishing, but is a dealer for several brands of fly equipment. Our conversation was with John Pillow. He said that the reel feels a little heavier than is normal, but that that added a heavy-duty tone to it. He believes that color will be very important in influencing buyer decisions. He said he believes there is a market for the product. John’s comments on packaging were similar to what we had learned before: most reels come in standard corrugate boxes and usually include some type of primary and secondary packaging. He also said that the neoprene pouches are useful, and again works primarily directly with the manufacturers of the reels.

In addition to talking to the owners of fly equipment stores, we had several conversations with fly fishermen about what type of packaging they wanted to see with their fly reels. Travis

Cox, a Cal Poly student who has worked as a summer fly-fishing guide, was of the opinion that a durable, hard case for a fly-fishing reel would add value to the product. He related that he had lost a reel before that was packaged in a soft pouch due to a severe impact.

Another important aspect of the background search for this project was analyzing the products that exist in competition with the Aspen reel. The table below outlines some of the major competitors' characteristics in a number of important categories.

Table 2 - Fly Reel Competitive Analysis

Brand	Price Range	Quality	Material	Package Type Internal	Package Type External	Graphics
Aspen RE-1046	$179-250	Precision machined, anodized one color, one piece construction	Aircraft aluminum	Neoprene zipper pouch with fuzzy cushion.	Normal RSC corrugated box (E flute)	White, Black, Basic Logos and minimal descriptions
Bauer	$295-435	Precision machined, anodized in many colors	Aerospace 6262-T6 bar-stock aluminum	Neoprene slip in pouch no zipper, logo on outside	Normal RSC corrugated box (E flute)	Plain box color, colored logo fonts
Orvis	$200-400	Precision machined, anodized in a few colors	Aerospace 6262-T6 bar-stock aluminum	Leather zipper pouch with fuzzy cushion. Silk sleeve pouch.	Normal RSC corrugated box (E flute)	Colors added, logos and descriptions,
Abel	$250-310	Precision machined, anodized in	Aerospace 6061-T651 cold	Neoprene/cloth slip in pouch with Velcro,	Normal RSC corrugated	Plain color box with black

		many colors	finished aluminum	with handle, logo on outside	box (E flute)	printed logos, solid color printed box with logos
Sage	$200-400	Precision machined, anodized in many colors	6061-T6 bar-stock aluminum	Neoprene slip in pouch with Velcro, logo on outside	Normal RSC corrugated box (E flute)	Plain box color, fish graphics, colorful logo
Ross	$170-300	Precision machined, anodized in grey, black, and copper,	6061-T6 proprietary aluminum alloy	Neoprene slip in pouch with Velcro, logo on outside	Normal RSC corrugated box (E flute)	Blue colored box, logos printed on each face
Redington	$180-240	Precision machined, anodized in black and titanium	6061-T6 bar-stock aluminum	Neoprene/cloth slip in pouch with Velcro, logo on outside	Normal RSC corrugated box (E flute)	One color printed box, river image, logos printed solid color
Galvan	$320-450	Precision machined, anodized in many colors	6061-T6 bar-stock aluminum	Slip pouch, cushion foam, very cheap and basic	Normal RSC corrugated box (E flute)	Basic box, plain logo font, black and white

As can be seen in Table 2, the Aspen RE-1046 is intended to be priced in the lower or middle sections of the market. It is being advertised as a reel that incorporates the high-quality, machined construction of the high-end reels but without the high cost that put those reels out of the reach of most fly-fishermen. It is a tough, capable, and durable reel, meant to be used hard in tough backwoods environments. This product philosophy was the inspiration to create a tough case that could be used for the fisherman for years and years while carrying the reel deep into the back-country.

Solution:

The end result of our background search was the decision to pursue the design and prototyping of a new type of fly-reel package. While most fly reels are packaged in soft pouches or bags, or even thin plastic, and shipped in corrugate containers, these packages are not extremely rugged. They do a perfectly adequate job of protecting the reels when they are safely indoors or on display, but this is not enough for some fishermen. Many fishermen hike far back into the wilderness with their reels or take them on canoe trips through rough streams. In the course of our design work, we evaluated many different features, structures, materials, and processes in order to create a package that would carry this valuable reel through such rough conditions. One of our first steps was to brainstorm which features we wanted the case to have, as illustrated in Table 3. Some of these ideas are continued from Table 1.

Table 3 – Design features of durable hard case

Feature	Description	Comments/Evaluation
Tough	The case needs to be impact resistant to the extent that it can be dropped from a moderate height, stepped on, and bumped around and still protect the reel.	This feature is non-negotiable and will depend largely on the material and design chosen.
Attractive	Although the overwhelming emphasis of this project is on the case's functionality, it will be important to the end user that the case be appealing and attractive.	This feature adds an acceptable amount of difficulty to the design process but is necessary to ensure the final product's marketability.
Cost-effective	We want to design this product in such a way that the client can choose to actually implement it cost-effectively.	This feature does add an acceptable amount of difficulty to the design process but is more heavily influenced by material and process selection.
Fit rod and reel together	The ability of the case to contain the reel while it is mounted on the rod	This feature adds a lot of complexity to the design of the case and causes other

	enables the user to protect his investment while hiking between fishing spots and transporting the reel in the bed of his pickup.	difficulties by conflicting with other features.
Buoyant	The case's ability to float with the reel inside.	This feature adds complexity to the design by necessitating the use of seals and will dictate the physical shape of the design and the material used.
Convenient	The case should be designed such that a fisherman will be able to easily carry it on his person by either attaching it to his pack or vest or with it occupying a minimum of space in his bag.	This feature dictates the physical size and shape of the case and could demand additional features (hooks, loops, etc.)

As can be seen in the "Comments/Evaluation" column of Table 3, all of these attributes were discussed and evaluated with regard to their importance and feasibility. Upon discussion, some of these original features were discarded as being either impractical or not important enough. The first to go was the requirement that the case be made to fit both the rod and reel together, as this would have made the design overly complicated and expensive and did not add enough value to justify. The result of this discussion was the creation of a list of initial design constraints and target values that gave us a starting point for the design and construction of the prototype.

Table 4 – Initial design constraints

Feature (Constraint)	Units of measure	Target value
Impact resistant (average man step-on)	Lbs of force	200
Impact resistant (drop)	Lbs of force	
Buoyancy	Float or no float	Float
Attractive	User approval	75%
Convenient	User approval	90%

Having decided on a set of initial constraints to work around, we set to work designing various structures that would contain the reel and meet these requirements. Table 5 outlines the different structures we initially considered for prototyping.

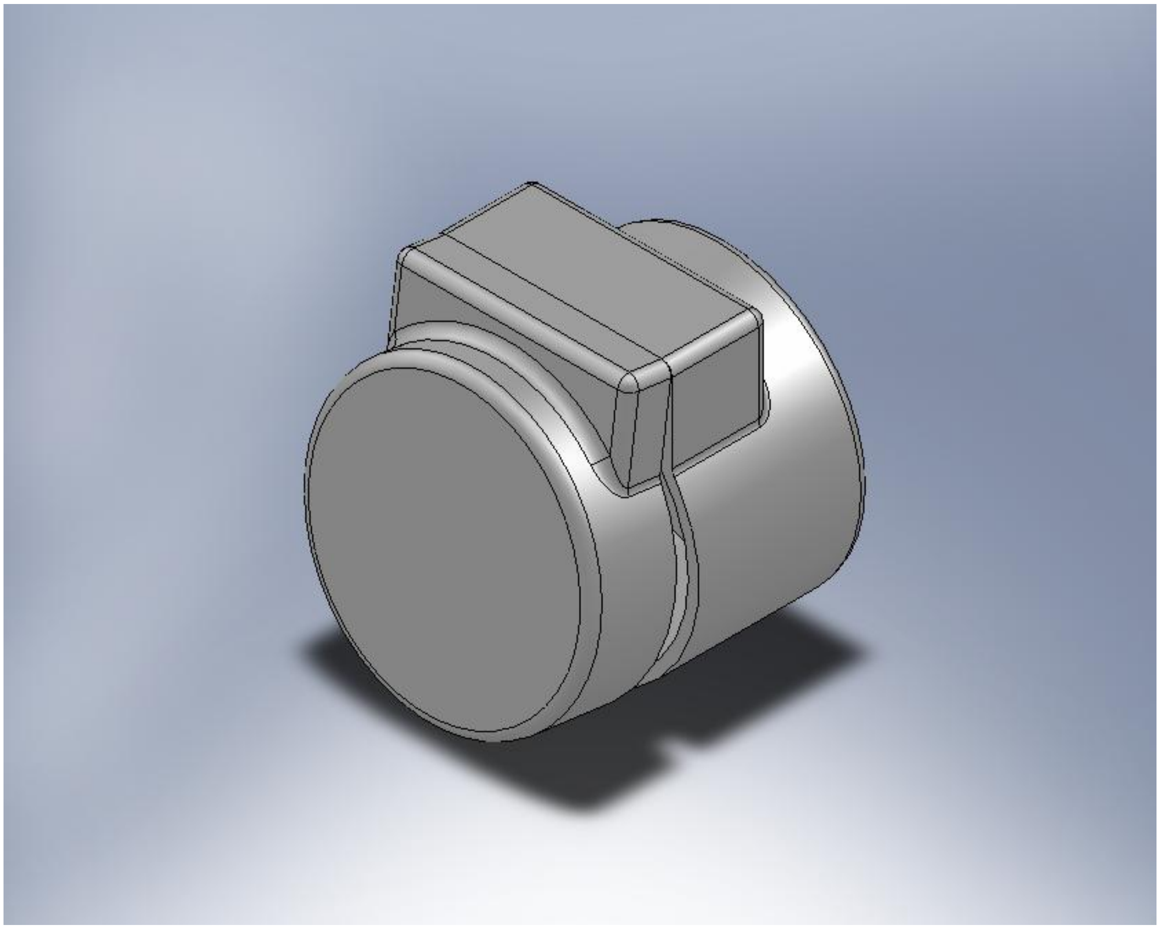
Table 5 – Potential structures based on design constraints

Structure	Image	Description	Comments
Cylinder		This design is a simple cylindrical case that would have been big enough (≈ 4" dia.) to contain the reel.	Easy to produce, this design would not be very sophisticated. Strength and buoyancy would be acceptable.
Horseshoe		This design has the basic shape of a horseshoe.	This design gives more consideration to space and shape efficiency and has a more complicated shape than the cylinder design, which could lead to increased attractiveness ratings. Strength and buoyancy are acceptable.
Flip-top		This design would be a rectangular-shaped object that would align with what might be called the reel's vertical axis and use a Zippo™-esque lid.	The reel may or may not be easier to put away in a case of this configuration.
Contoured		This design is more or less a cylinder about the size of the reel's body with a rectangle above it about the size of the reel's foot. The effect is a case with a 3D contour of the reel.	This design offers a sleek look and occupies less space at the cost of increased design and construction complexity.

Each of these structures had advantages and disadvantages in terms of space utilization, design and construction complexity, and processability. Despite its inherent complexity, we chose to move to the prototype stage with the contoured design because of its efficient use of space and sleek appearance. Figure 1 shows the earliest version of this design.

Figure 1 – Early “contoured” prototype

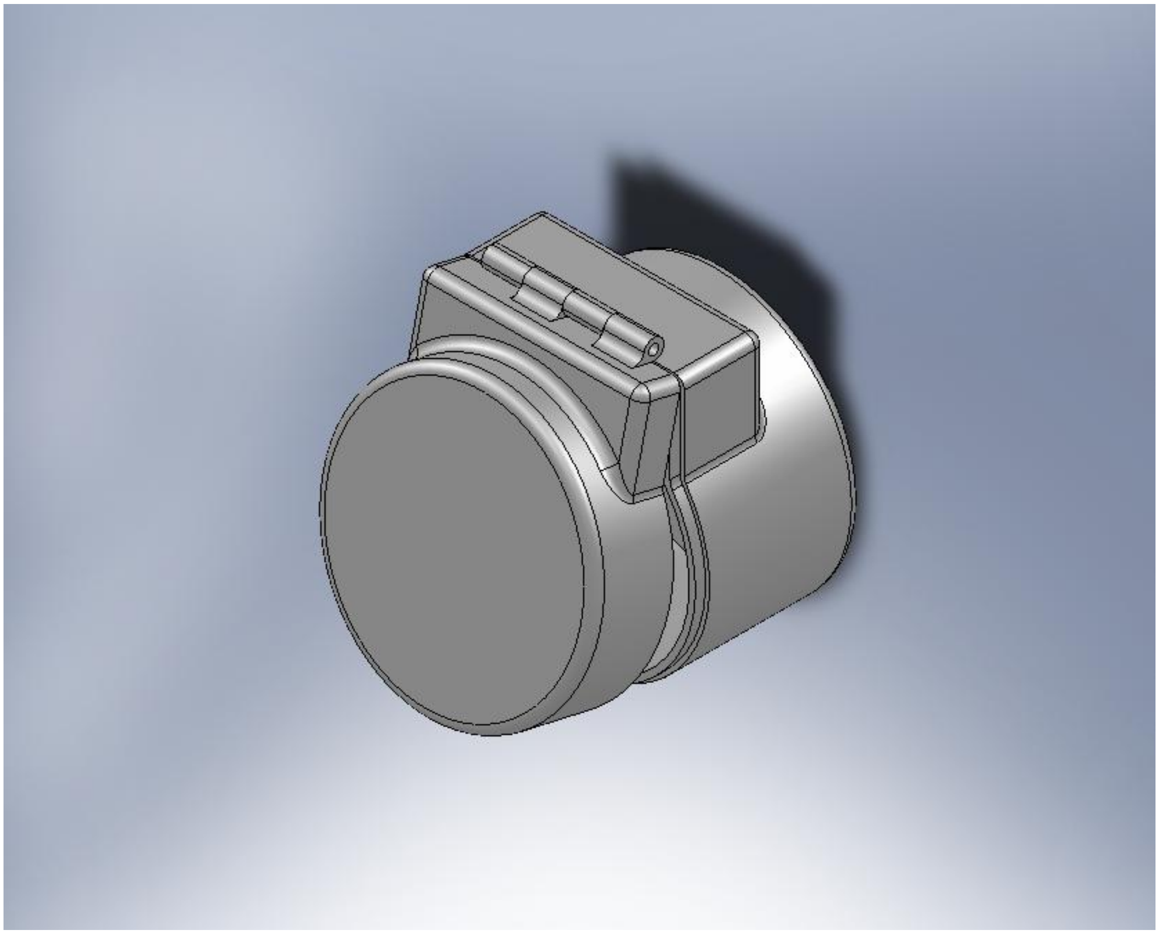
Screenshot of early design – no hinges or sealing interface



Starting with that basic shape, the design moved on to incorporate hinges and a sealing interface, as shown in Figure 2.

Figure 2 – Case with hinges and sealing lips

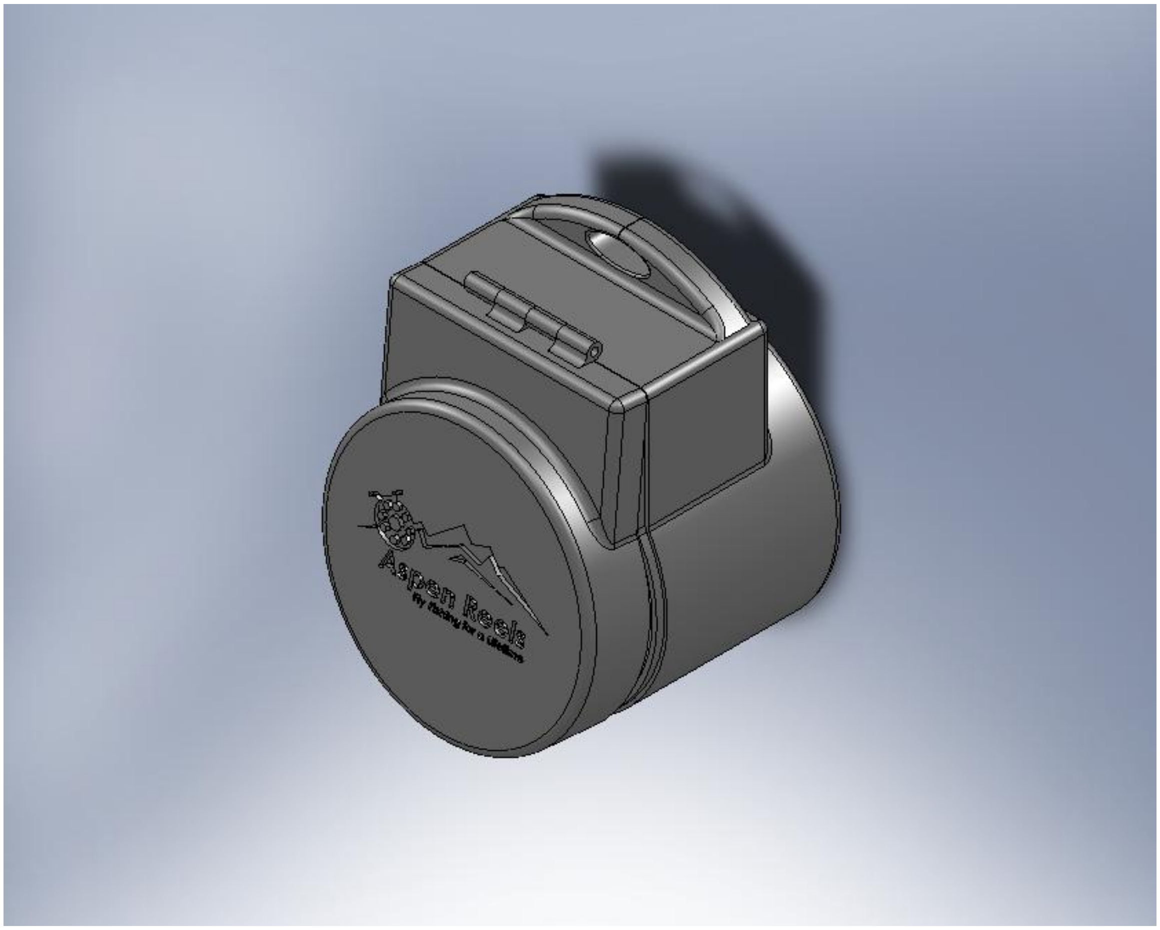
Screenshot of case as of first prototype printing



The case as represented in Figure 2 was actually physically prototyped, which gave us the opportunity to get feedback and visually evaluate the design. Based on that evaluation, the design was changed to incorporate additional features and a new mating surface, as can be seen in Figure 3.

Figure 3 – Current design, pending further review and testing

Most recent; graphics, loop, scaled bigger, ect.



The shape of the design provided some constraints that helped decide which manufacturing process should be used to produce the part. Table 6 defines these constraints.

Table 6 – Manufacturing process selection

Process	Materials possible	Design possible	Comments	Capability at IT facilities
Machining	Metals, composites, polymers, wood	Yes	Time-consuming, expensive, good finish	Yes
Stamping/thermoforming	Metals, composites, polymers	Not with hinges	Quick, well-suited for mass production, high tooling cost	Limited
Casting	Metals, polymers	Yes	High tooling cost and complexity, low-strength, moderate finish	Limited
Hand lay-up	Composite	Marginal	Slow, relatively cheap, imprecise, imperfect finish, sealing surfaces and hinges difficult	Yes
Compression molding	Polymers	Yes	Expensive tooling, good finish, would require additional processes	Yes
Injection Molding	Polymers, composites	Yes	Expensive tooling, good finish, quick, high-production	Limited
Direct Manufacturing	Polymers	Yes	Slow, expensive, only certain materials available, no set-up or tooling costs	Yes

After reviewing the processes outlined in Table 6, we decided to select injection molding as the primary production process. However, our ability to injection-mold parts was limited, so we used a rapid prototype machine to print out prototypes for visual inspection. The next step was to decide which materials and processes to use to produce the product. Table 7 outlines the criteria we decided to use to select a material.

Table 7 – Material criteria

Attribute	Description	Target Numerical Value
Lightweight	The buoyancy of an object is more influenced by its density than by its weight, so in this case "lightweight" implies not only that the material will be easily carried by the user, but is also low in density	.05 Lbs/in^3
Strong	The material must be sufficiently resistant to impact forces and crushing loads to protect the reel through inadvertent drops and being stepped on by clumsy fishermen.	10 ksi compression strength
Affordable	Despite being high-performance, the material cannot be so exotic that its availability and price raise the cost of the final product too high.	$2.25/lb
Manufacturable	The material must be processable by contemporary mass-production techniques in an economical fashion	Must be able to be injection molded.
Durable	The material must be able to perform for years in salt and fresh water environments	"Very good" in salt and fresh water
Non-toxic	The material should be safe for the user, the environment, and the manufacturer.	"Non-toxic" rating

Having set numerical target values for the material we were searching for, we used the material database program CES to look for a material that met or exceeded our requirements. The program has a function that allows the user to input constraints and it filters through its database of materials and shows the ones that pass the test. Table 8 lists the materials we chose from the list CES provided that matched our criteria.

Table 8 – Possible Materials

Material	Lightweight (≤.05 lbs/in^3)	Strong(≥10 ksi comp.)	Affordable (≤ $2.25/lb)	Manufacturable (Injection-molding)	Durable ("Very Good" Rating)	Non-Toxic
ABS (20% Glass fiber)	.0495	13.5	1.76	Yes	Yes	Yes
PA (Type 6)	.0409	14.5	1.69	Yes	Yes	Yes
PA (Type 66, 15% Glass fiber)	.0459	17.45	2.06	Yes	Yes	Yes
PA (Type 66, 25-30% Glass fiber, High impact)	.0484	13.375	1.64	Yes	Yes	Yes
PC (25%	.0501	20.55	1.85	Yes	Yes	Yes

Long Glass fiber)						
PP (40% Long Glass fiber)	.0438	18.7	1.80	Yes	Yes	Yes

Since there were still at this point several materials that would work with our requirements, we decided to test the three strongest materials and then see which of those was the most commercially available before deciding on a final material choice. This meant that we would test the PC (25% long glass fiber), PP (40% long glass fiber), and PA (Type 66, 15% glass fiber) materials. These abbreviations are the standard way to reference these materials, but for reference, PC is polycarbonate, PP is polypropylene, and PA is polyamide.

Having researched and discussed features, structures, materials, and processes, we were able to condense our project goals at this point. The case would be an injection-molded, polymeric piece that would have shape similar to that of the reel, and with all of the features outlined in Table 4. The next step was to test the design.

Results:

With design and materials in hand, the two next steps in the project were to design the part using Computer-Aided Design (CAD) software and create a prototype for visual review. Due to our lack of ability to injection-mold an actual part on-site, we were not able to manufacture a functional prototype. However, a CAD file allowed us to perform Finite Element Analysis (FEA) on our design to test if it would withstand the loads designed to be placed upon it. The rapid-prototyped piece gave us the ability to evaluate the case's aesthetics, convenience, and everything else but its strength.

In order to test our design's structural performance, we drew it in SolidWorks, which has the capability to perform FEA. The main thing we wanted to find out from this testing was whether or not the case would withstand being stepped on by a 200-pound fly-fisherman. In order to do so, we used the information from CES to define our candidate materials in the SolidWorks materials library and then used the Simulation Xpress feature to simulate loads on the case. We performed this test three times, once with each of the materials we were considering using. Figures 4, 5, and 6 summarize the outcomes of these tests, while complete test reports can be seen in the appendix.

To see the results from testing each material, PA (Type 66, 15% glass fiber), PC (25% long glass fiber), and PP (40% long glass fiber), refer to Table 9 below for comparison. PC came out on the top with the best Stress and Displacement values compared to PA and PP. It could withstand a stress minimum higher than PA but lower than PP, however the maximum stress value still came out the highest in testing. As for displacement, PC had the lowest compression displacement of the three materials; this means the case compressed the least with the 200lb force on top. It only displaced .00063139 mm, which is very little; we could increase the maximum test force well above the 200lb starting weight. After reviewing the testing results, PC will be the recommended material for the company regarding structural performance. Other factors will need to be decided on a material selection based on price, weight, manufacturability, and so forth.

Table 9 – Stress and Displacement Comparison

	Min Stress	Max Stress	Min Displacement	Max Displacement
PA	52.4668 N/m^2	1.7851e+007 N/m^2	0 mm	0.786723 mm
PC	57.5886 N/m^2	1.79285e+007 N/m^2	0 mm	0.00063139 mm
PP	72.3666 N/m^2	1.79204e+007 N/m^2	0 mm	0.000693617 mm

Figure 4 - Impact and compression test – PA (Type 66, 15% glass fiber)

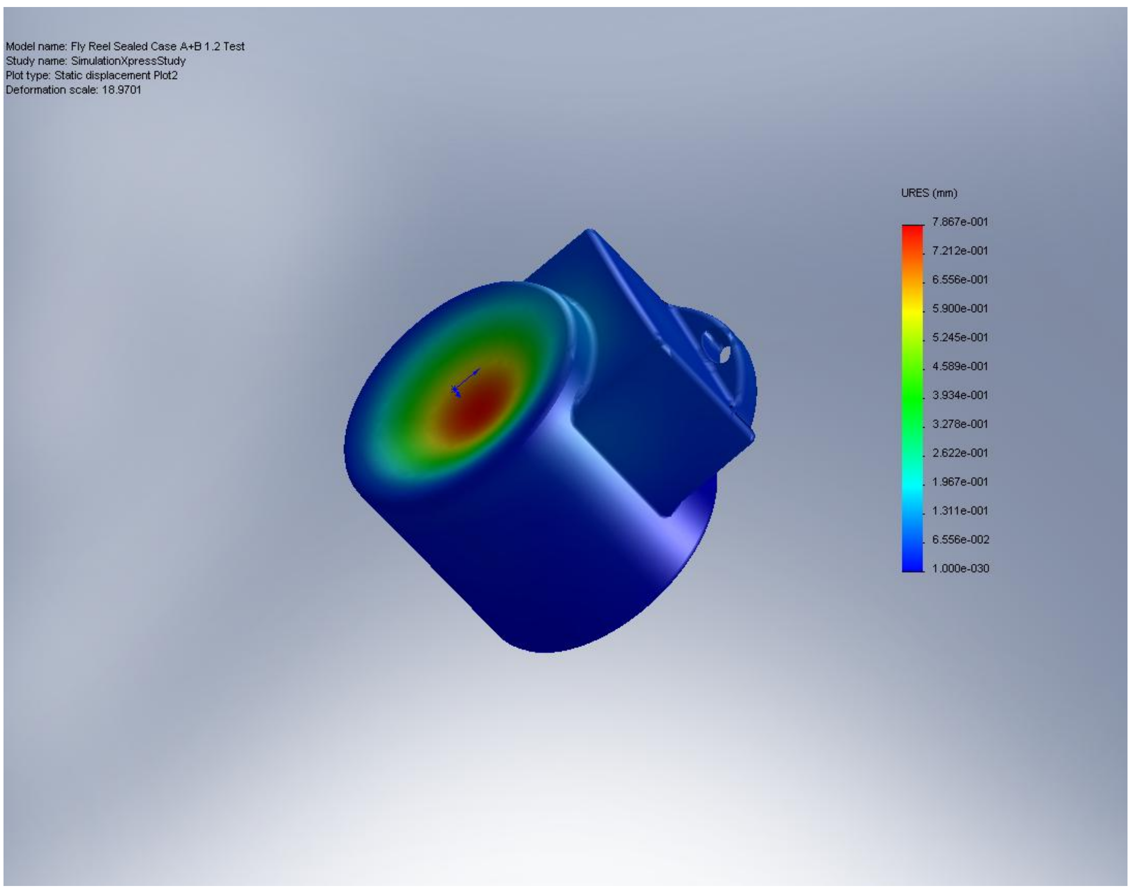


Figure 5 - Impact and compression test – PC (25% long glass fiber)

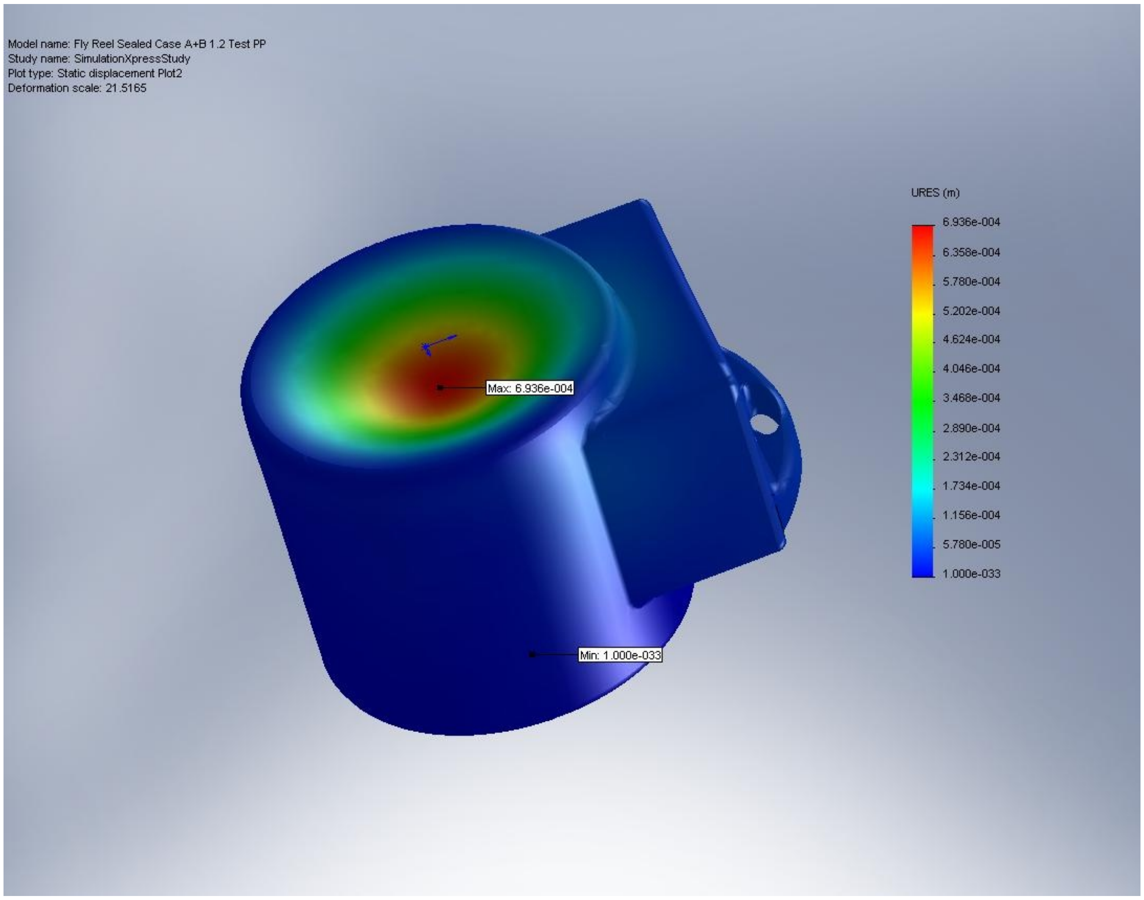
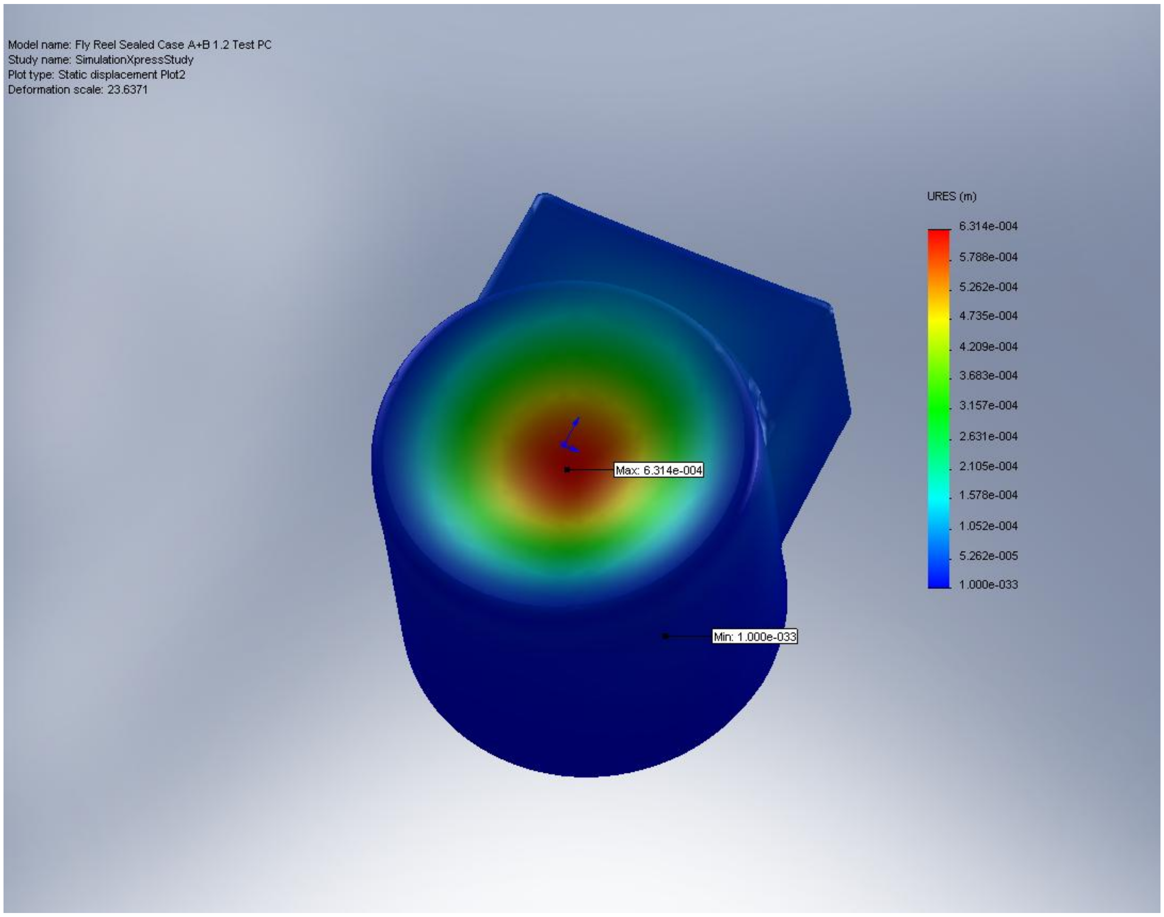


Figure 6 - Impact and compression test – PP (40% long glass fiber)



Conclusions/Observations:

Market considerations

This case is intended to add value to the Aspen Reels product line in two ways: as a point of differentiation for the RE-1046 that will increase its sales, and as a potential stand-alone product.

There are a myriad of choices facing a customer shopping for a new fly-fishing reel, and it is crucial that any reel wishing to be competitive be significantly different and better than all the others on the shelf next to it. This differentiation can come from many directions; price, weight, feel, color, shape, type of drag, and many others. The Aspen RE-1046 has some features built into it that distinguish it from the competition. It is heavy-duty, has a more convenient drag arrangement, has rugged styling, and is well priced given its machined construction. If it came in a rugged case that could be used to carry it through the wilderness unharmed, the potential buyer would have one more reason to choose it over the five or six similarly performing alternatives next to it.

In addition to housing the RE-1046, it is entirely possible that this case could be used to hold just about any reel in the same size range. There would be some modifications necessary in the secondary cushioning material inside the case, but the exterior of the case will not require modification. If there is sufficient demand, the case could then be produced and sold separately either directly to the customer, or perhaps to other reel manufacturers, although this would not be the most desirable as it would lessen the Aspen's competitive advantage.

Pricing/cost analysis

In order to get an idea of how practical it would be to enter into production with this design, we contacted a company that specializes in quick injection molding quotes. Protomold is based in Minnesota and provides quotes on part files submitted over the internet within 24 hours. Their response includes whether or not the design can be injection molded, suggestions for improving its moldability, an analysis of potential problem spots, and a cost breakdown. The quote is interactive, so the customer can change the quantity desired in a drop-down menu and watch the price change automatically.

According to the response we received from Protomold, there would be some design changes necessary to injection mold this part. The most significant of these is the need to either eliminate or redesign the hinges on the top of the case. Protomold calls the region between the hinges and the karabiner loop an “undercut” which they are incapable of producing. Future designs could eliminate this problem by removing the hinges from the molded parts and adding separate hinges later. The other changes they advised primarily involved adding draft angles to various surfaces in order to ease mold machining and part ejection. The initial cost of tooling for injection molding is usually very high because of the high cost of machining the molds, and this design is no exception. Table 10 details the pricing data from Protomold.

Table 10 – Injection molding quote

	Tooling cost[1]	Price/part	Qty: 500[2]	Qty: 1000[2]
Bottom Half	$8,190	$9.24	$5,120	$9,740
Top Half	$7,110	$5.52	$3,260	$6,020
Total	$15,300	$14.76	$8,380	$15,760

[1]One-time cost

[2]Based on price/part and $500 setup charge

Based on the data in Table 10, the ultimate price per part based on a 500-part quantity and accounting for the $500 setup charge is $16.76. If the one-time tooling cost is included in the first run of 500 parts, this number goes up to $47.36. This does not include any of the cost added by shipping and handling. This means that altogether we have ended up with a design that could add nearly $50 or more to the price of the first 500 reels, which may be enough to hurt its competitiveness next to other similar products. However, this is based on one quote from one company, and is based on a prototype version of the design. It should also be noted that this company specializes in getting quotes to customers within 24 hours of file upload and we did not sit down with a manufacturing specialist from the company, which calls the accuracy of the quote into question. It would be possible for us to eliminate some of the complexities of the design in order to make it cheaper to produce, albeit at the risk of hurting its attractiveness to consumers. Also, tool and die manufacturing is not the specialty of our client in this project, but it could be possible for them to machine the molds in-house, and therefore reduce the cost of the tooling. It is, however, questionable that an injection molding company would be willing to agree to such an arrangement.

Aspen Reels is currently planning on running only a few hundred reels at a time, which leads to the conclusion that the cost of this case might be prohibitive until higher quantities are required. However, as a spinoff product, it would be feasible to produce parts in the range of 5,000 to 10,000 units, at which point the price per part drops significantly.

Conclusions drawn from project

During the course of this project, we have laid some of the early-stage groundwork for the adoption of a new package. Having looked at the fly reel market as a whole and talked to fly fishing experts, we decided to design a hard and durable case as a solution. We decided on a structure, selected materials, and specified a manufacturing process. We then performed computerized testing on the design with different materials and selected the strongest one. Our final step was to take our design and material and obtain a rough estimate of the cost involved with producing this case in a manufacturing environment.

In addition to the early steps taken by this project, there would be much additional work involved in actually incorporating this case design into Aspen's product line. The design needs to be altered to increase its compatibility with the injection molding process, as well as possibly to incorporate further improvements or features as opportunities are recognized. We set initial goals of 75% consumer approval on the aesthetics of the case and 90% approval for convenience. These goals need to be tested on a sampling of fly-fishermen. The manufacturing bidding process needs to be expanded to include multiple prospects, especially ones that are geographically close to Aspen's location. A structurally sound prototype is required in order to perform final design changes and testing, and perhaps even a small run should be ordered to conduct some consumer testing.

The work done on this project in the areas of market research, part design, and process and cost analysis supports the drawing of several conclusions that form the basis of our final recommendation to the client. The size of the fly-fishing market, combined with the feedback garnered from several people involved in the industry, indicates that this case design has the potential to enhance the competitiveness of Aspen's product and increase the company's revenues. However, given the relatively high start-up cost of manufacturing these cases, it is probably in Aspen's best interest to wait until its production volume exceeds 1,000 units per year. By then, the company will have a better idea as to its position in the fly reel market and will be ready to start considering investing more money in the product line. This may seem counterintuitive, as the case would be one of the selling points of the reel in the first place, and in a big company it indeed should be used from the start. However, the company in question here is relatively small and does not have the capital to spend on a new, uncertain product offering. If the company wanted to produce and market the cases as a separate product, it would need to decide if it was willing to work on the magnitude of 5,000 units or more, where the price per case is more reasonable.

This case could provided added value to the Aspen Reels product line and would distinguish its self from other Fly Reel manufactures around the world. We believe that this case has great potential as a revenue-booster for the company, and with more development and planning, should be implemented after Aspen Reels has established a spot in the marketplace.

References:

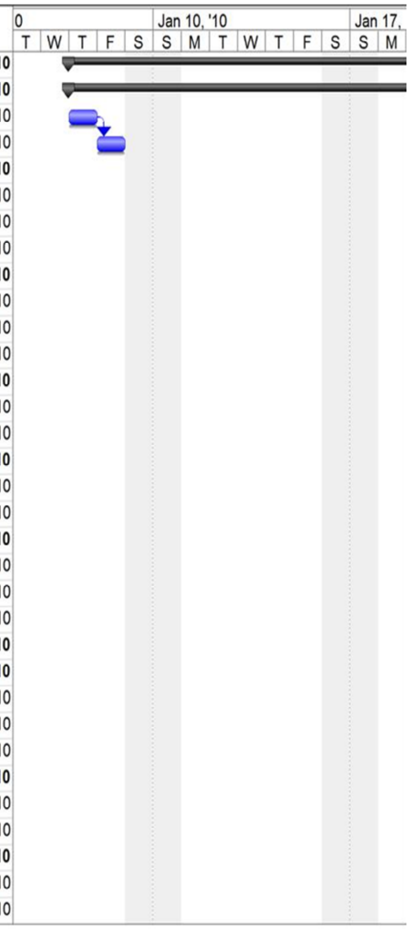
Fly Fishing Reel Market Analysis

Leisure Trends Group. 2008. “The Fly-Fishing Retail Market in the United States 2008” Slides 1-142

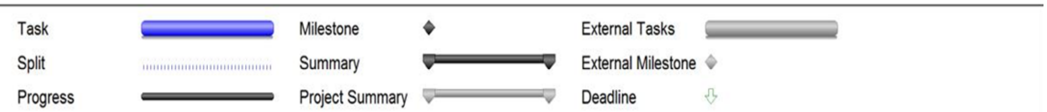
Appendix:

Gantt Chart

ID	Task Name	Duration	Start	Finish
1	**Aspen Reels Senior Project - Ted Bramble and Andrew Eskildsen**	**107 days**	**Thu 1/7/10**	**Fri 6/4/10**
2	**Winter Quarter 2010**	**47 days**	**Thu 1/7/10**	**Fri 3/12/10**
3	Form teams in class and make appointment with Lou Tornatzky	1 day	Thu 1/7/10	Thu 1/7/10
4	Meeting with Lou Tornatzky to discuss potential project ideas	1 day	Fri 1/8/10	Fri 1/8/10
5	**Project Proposal**	**2 days**	**Wed 1/20/10**	**Thu 1/21/10**
6	Call industry advisor and discuss project proposal	1 day	Wed 1/20/10	Wed 1/20/10
7	Finalize and review project proposal	1 day	Wed 1/20/10	Wed 1/20/10
8	Submit project proposal to Lou Tornatzky	1 day	Thu 1/21/10	Thu 1/21/10
9	**Progress Report #1**	**4 days**	**Mon 2/1/10**	**Thu 2/4/10**
10	Discuss progress report details	1 day	Mon 2/1/10	Mon 2/1/10
11	Finalize and review progress report #1	4 days	Mon 2/1/10	Thu 2/4/10
12	Submit progress report #1 to Lou Tornatzky	1 day	Thu 2/4/10	Thu 2/4/10
13	**Research**	**13 days**	**Fri 2/5/10**	**Tue 2/23/10**
14	Online research, fourms, competition, movies	13 days	Fri 2/5/10	Tue 2/23/10
15	Field research, fly fishing, stores, communitiy	13 days	Fri 2/5/10	Tue 2/23/10
16	**Package Brainstorming**	**13 days**	**Wed 2/24/10**	**Fri 3/12/10**
17	Organize ideas from research	13 days	Wed 2/24/10	Fri 3/12/10
18	Continue to research packaging methods	13 days	Wed 2/24/10	Fri 3/12/10
19	**Progress Report #2**	**4 days**	**Mon 3/1/10**	**Thu 3/4/10**
20	Discuss progress report details	1 day	Mon 3/1/10	Mon 3/1/10
21	Finalize and review progress report #2	4 days	Mon 3/1/10	Thu 3/4/10
22	Submit progress report #2 to Lou Tornatzky	1 day	Thu 3/4/10	Thu 3/4/10
23	**Spring Quarter 2010**	**40 days**	**Mon 4/12/10**	**Fri 6/4/10**
24	**Progress Report #3**	**4 days**	**Mon 4/12/10**	**Thu 4/15/10**
25	Discuss prodress report details	1 day	Mon 4/12/10	Mon 4/12/10
26	Finalize and review progress report #3	4 days	Mon 4/12/10	Thu 4/15/10
27	Submit progress report #3 to Lou Tornatzky	1 day	Mon 4/12/10	Mon 4/12/10
28	**Draft Final Report**	**20 days**	**Mon 4/19/10**	**Fri 5/14/10**
29	Finish 80-90% of Final Report	20 days	Mon 4/19/10	Fri 5/14/10
30	Finish Prototyping Fly Reel Case	20 days	Mon 4/19/10	Fri 5/14/10
31	**Final Report**	**14 days**	**Tue 5/18/10**	**Fri 6/4/10**
32	Submit Final Report to Lou Tornatzky	14 days	Tue 5/18/10	Fri 6/4/10
33	Final Prototype Reel Case	14 days	Tue 5/18/10	Fri 6/4/10



Project: Aspen Reels Senior Project
Date: Wed 6/2/10



Page 1

HTML Reports from SolidWorks Simulation Xpress Testing

PA (Type 66, 15% glass fiber):

Report Contents

1. File Information
2. Materials
3. Load & Restraint Information
4. Study Property
5. Results
    a. Stress
    b. Displacement
    c. Displacement
    d. Factor of Safety
6. Appendix

1. File Information

Model name:	Fly Reel Sealed Case A+B 1.2 Test
Model location:	F:\IT 461 & 462\Fly Reel Testing\Fly Reel Sealed Case A+B 1.2 Test.sldprt
Results location:	C:\DOCUME~1\Student\LOCALS~1\Temp
Study name:	SimulationXpressStudy (-Default-)

2. Materials

No.	Body Name	Material	Mass	Volume
1	Fly Reel Sealed Case A+B 1.2 Test	[SW]PA (Type 66, 15% Glass Fiber)	0.260167 kg	0.000204774 m^3

2. Load & Restraint Information

Fixture		
Restraint1 <Fly Reel Sealed Case A+B 1.2 Test>	on **1 Face(s)** immovable (no translation).	

Load		
Load1 <Fly Reel Sealed Case A+B 1.2 Test>	on **1 Face(s)** apply normal force **200 lb** using uniform distribution	

4. Study Property

Mesh Information	
Mesh Type:	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Smooth Surface:	On
Jacobian Check:	4 Points
Element Size:	0.27767 in
Tolerance:	0.013884 in
Quality:	High
Number of elements:	8418
Number of nodes:	16679
Time to complete mesh(hh;mm;ss):	00:00:09
Computer name:	ITLAB15

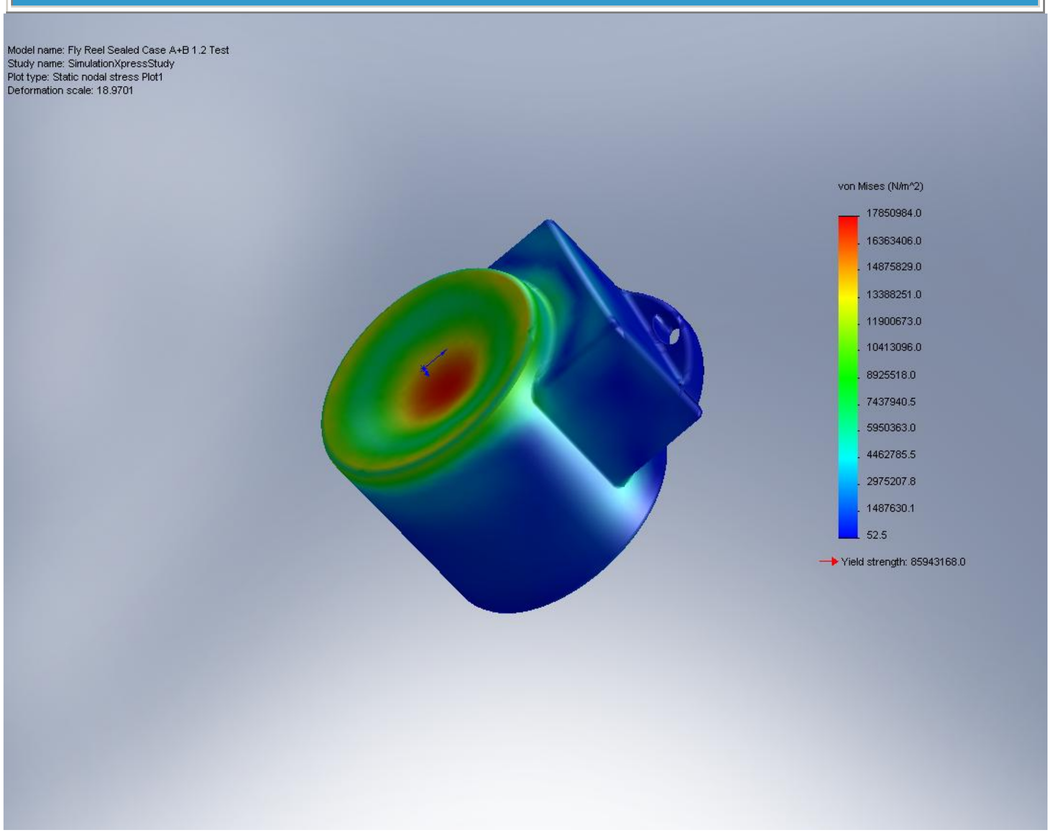
Solver Information	
Quality:	High
Solver Type:	Automatic

5. Results

5a. Stress

Name	Type	Min	Location	Max	Location
Plot1	VON: von Mises Stress	52.4668 N/m^2	(-0.660401 in, 7.19569e-009 in, -4 in)	1.7851e+007 N/m^2	(-0.0324917 in, 0.00989396 in, -0.586462 in)

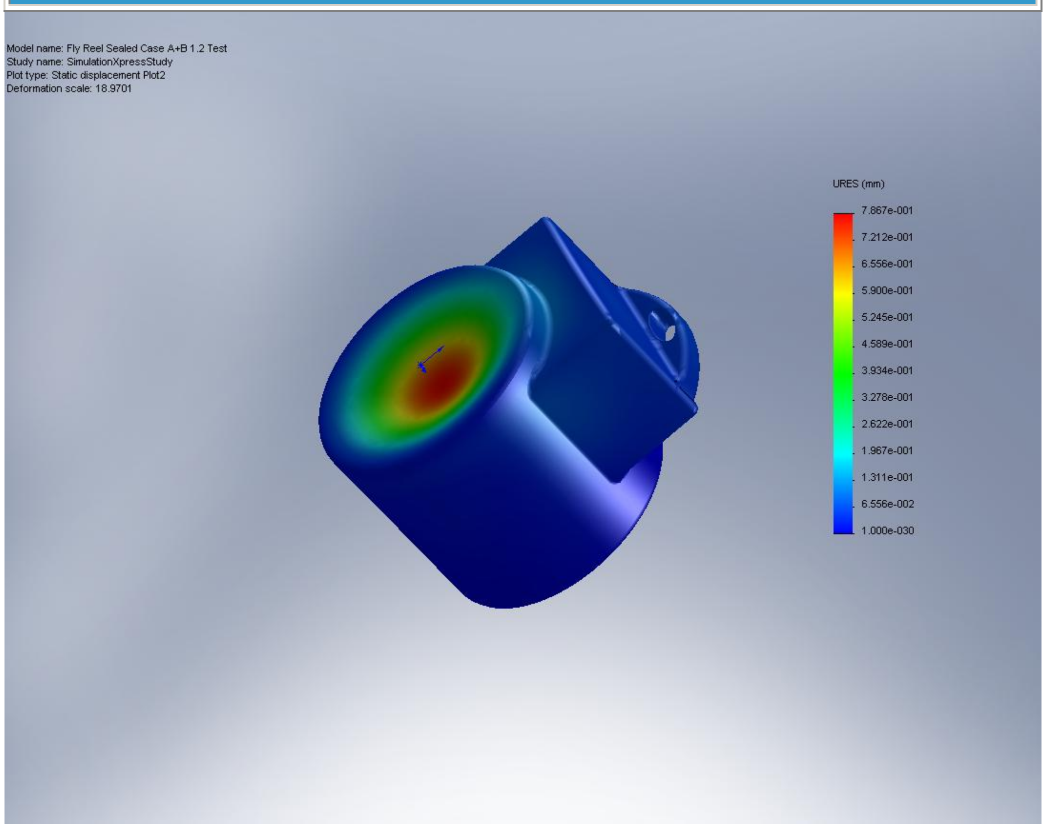
Fly Reel Sealed Case A+B 1.2 Test-SimulationXpressStudy-Stress-Plot1



5b. Displacement

Name	Type	Min	Location	Max	Location
Plot2	URES: Resultant Displacement	0 mm	(-1.03125 in, 1.78618 in, -4 in)	0.786723 mm	(-0.0334289 in, 0.0089117 in, -0.65 in)

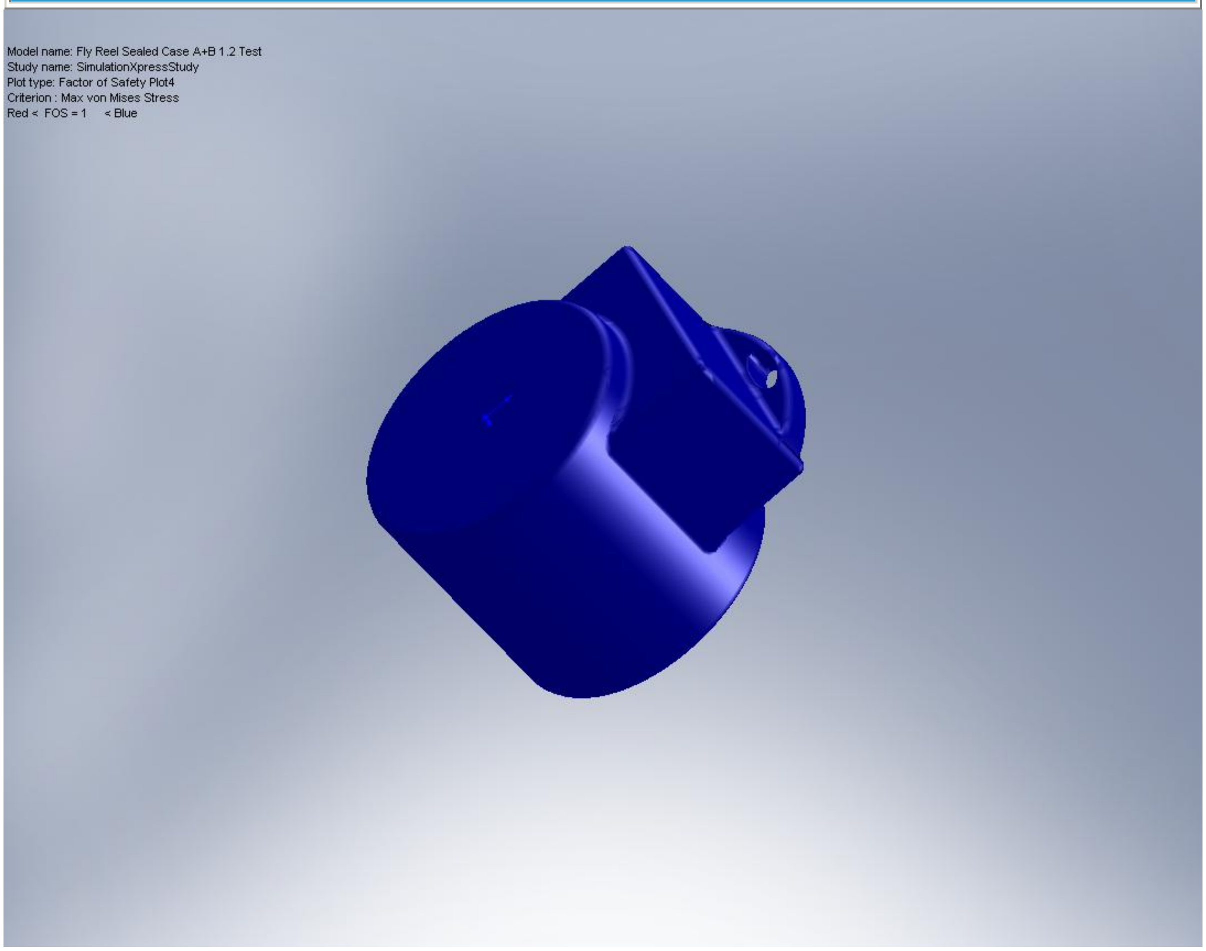
Fly Reel Sealed Case A+B 1.2 Test-SimulationXpressStudy-Displacement-Plot2



5c. Displacement

5d. Factor of Safety

Fly Reel Sealed Case A+B 1.2 Test-SimulationXpressStudy-Factor of Safety-Plot4



6. Appendix

Material name:	[SW]PA (Type 66, 15% Glass Fiber)
Description:	
Material Source:	
Material Model Type:	Linear Elastic Isotropic
Default Failure Criterion:	Max von Mises Stress
Application Data:	

Property Name	**Value**	**Units**
Elastic modulus	7.4912e+009	N/m^2
Poisson's ratio	0.35	NA
Mass density	1270.5	kg/m^3
Yield strength	8.5943e+007	N/m^2

PC (25% long glass fiber):

1. File Information

Model name:	Fly Reel Sealed Case A+B 1.2 Test PC
Model location:	F:\IT 461 & 462\Fly Reel Testing\Fly Reel Sealed Case A+B 1.2 Test PC.SLDPRT
Results location:	C:\DOCUME~1\Student\LOCALS~1\Temp
Study name:	SimulationXpressStudy (-Default-)

2. Materials

No.	Body Name	Material	Mass	Volume
1	Fly Reel Sealed Case A+B 1.2 Test	[SW]PC (25% Long Glass Fiber)	0.28369 kg	0.000204774 m^3

3. Load & Restraint Information

Fixture		
Restraint1 <Fly Reel Sealed Case A+B 1.2 Test PC>	on **1 Face(s)** immovable (no translation).	

Load		
Load1 <Fly Reel Sealed Case A+B 1.2 Test PC>	on **1 Face(s)** apply normal force **200 lb** using uniform distribution	

4. Study Property

Mesh Information	
Mesh Type:	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Smooth Surface:	On
Jacobian Check:	4 Points
Element Size:	0.27767 in
Tolerance:	0.013884 in
Quality:	High
Number of elements:	8418
Number of nodes:	16679
Time to complete mesh(hh;mm;ss):	00:00:08
Computer name:	ITLAB15

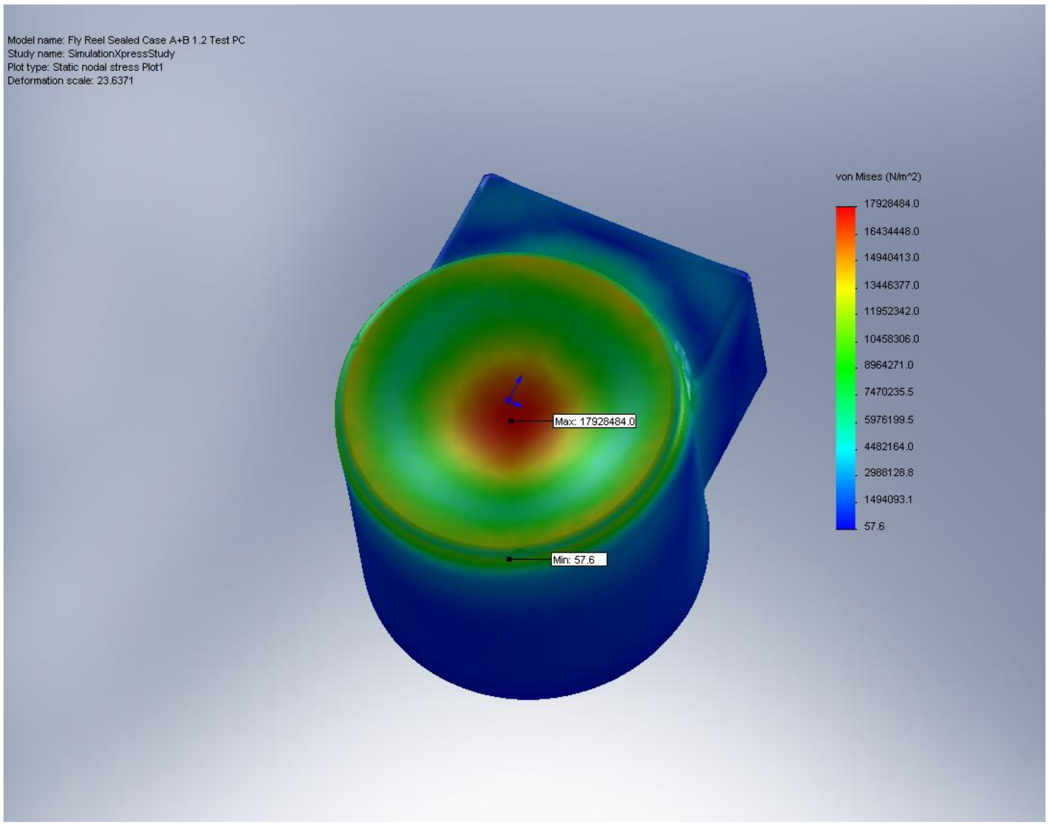
Solver Information	
Quality:	High
Solver Type:	Automatic

5. Results

5a. Stress

Name	Type	Min	Location	Max	Location
Plot1	VON: von Mises Stress	57.5886 N/m^2	(-0.25753 in, -0.284743 in, -4 in)	1.79285e+007 N/m^2	(-0.0324636 in, 0.00995458 in, -0.586429 in)

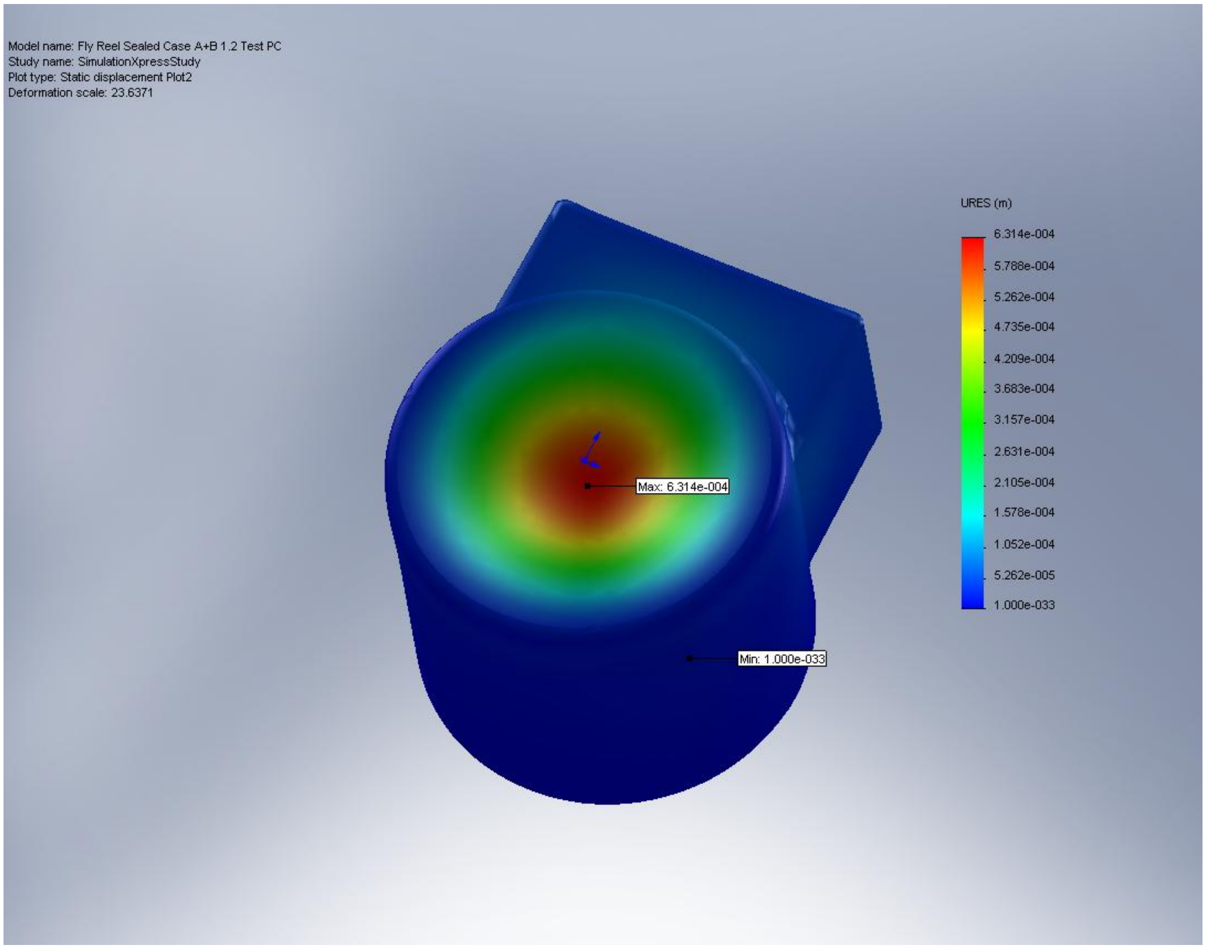
Fly Reel Sealed Case A+B 1.2 Test PC-SimulationXpressStudy-Stress-Plot1



5b. Displacement

Name	Type	Min	Location	Max	Location
Plot2	URES: Resultant Displacement	0 m	(-1.03125 in, 1.78618 in, -4 in)	0.00063139 m	(-0.0334221 in, 0.00894934 in, -0.65 in)

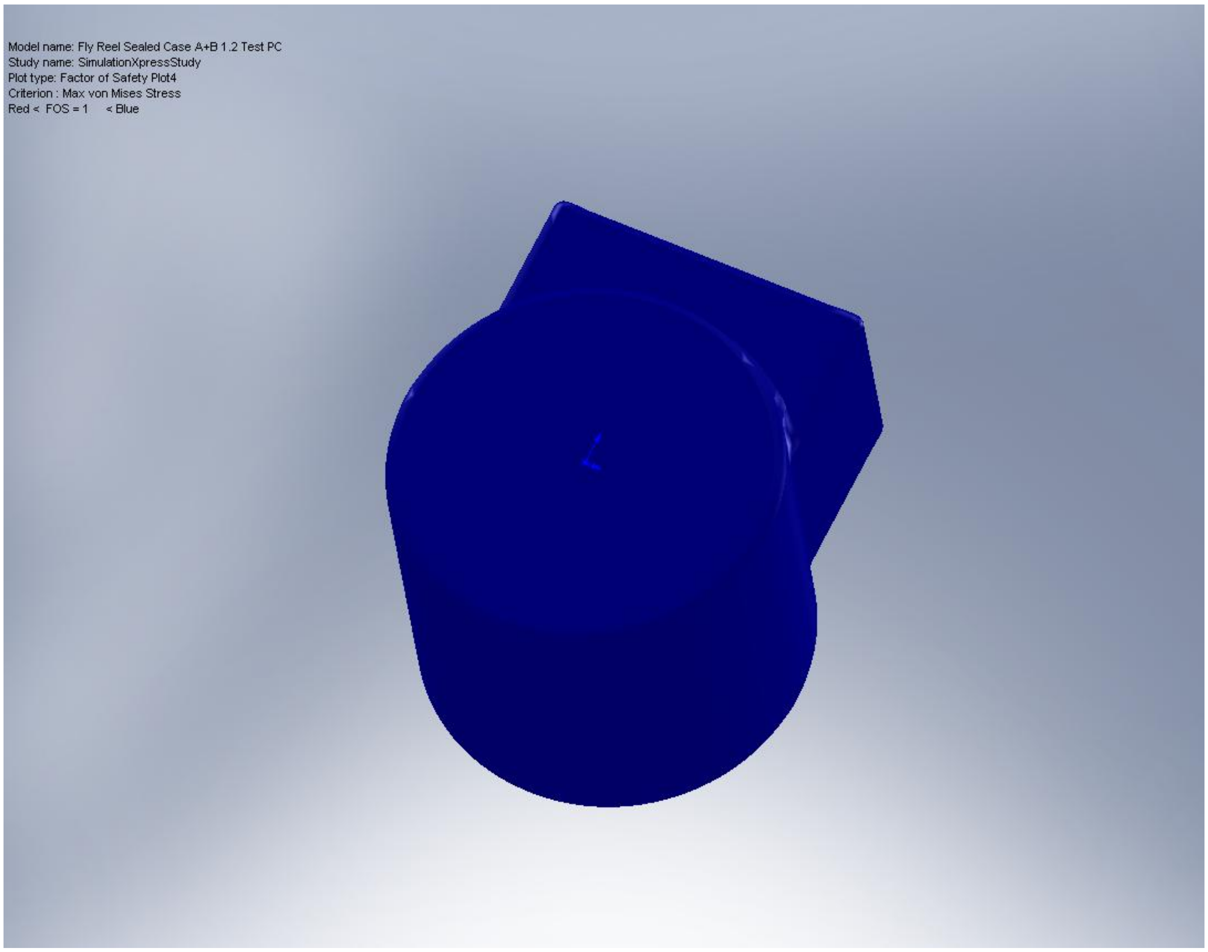
Fly Reel Sealed Case A+B 1.2 Test PC-SimulationXpressStudy-Displacement-Plot2



5c. Displacement

5d. Factor of Saxxxixxxxixfety

Fly Reel Sealed Case A+B 1.2 Test PC-SimulationXpressStudy-Factor of Safety-Plot4



6. Appendix

Material name:	[SW]PC (25% Long Glass Fiber)
Description:	
Material Source:	
Material Model Type:	Linear Elastic Isotropic
Default Failure Criterion:	Max von Mises Stress
Application Data:	

Property Name	**Value**	**Units**
Elastic modulus	9.2735e+009	N/m^2
Poisson's ratio	0.3575	NA
Mass density	1385.4	kg/m^3
Yield strength	1.1307e+008	N/m^2

PP (40% long glass fiber):

1. File Information

Model name:	Fly Reel Sealed Case A+B 1.2 Test PP
Model location:	F:\IT 461 & 462\Fly Reel Testing\Fly Reel Sealed Case A+B 1.2 Test PP.SLDPRT
Results location:	c:\docume~1\student\locals~1\temp
Study name:	SimulationXpressStudy (-Default-)

2. Materials

No.	Body Name	Material	Mass	Volume
1	Fly Reel Sealed Case A+B 1.2 Test PP	[SW]PP (40% long glass fiber)	0.248264 kg	0.000204774 m^3

3. Load & Restraint Information

Fixture		
Restraint1 <Fly Reel Sealed Case A+B 1.2 Test PP>	on **1 Face(s)** immovable (no translation).	

Load		
Load1 <Fly Reel Sealed Case A+B 1.2 Test PP>	on **1 Face(s)** apply normal force **200 lb** using uniform distribution	

4. Study Property

Mesh Information	
Mesh Type:	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Smooth Surface:	On
Jacobian Check:	4 Points
Element Size:	0.27767 in
Tolerance:	0.013884 in
Quality:	High
Number of elements:	8418
Number of nodes:	16679
Time to complete mesh(hh;mm;ss):	00:00:08
Computer name:	ITLAB15

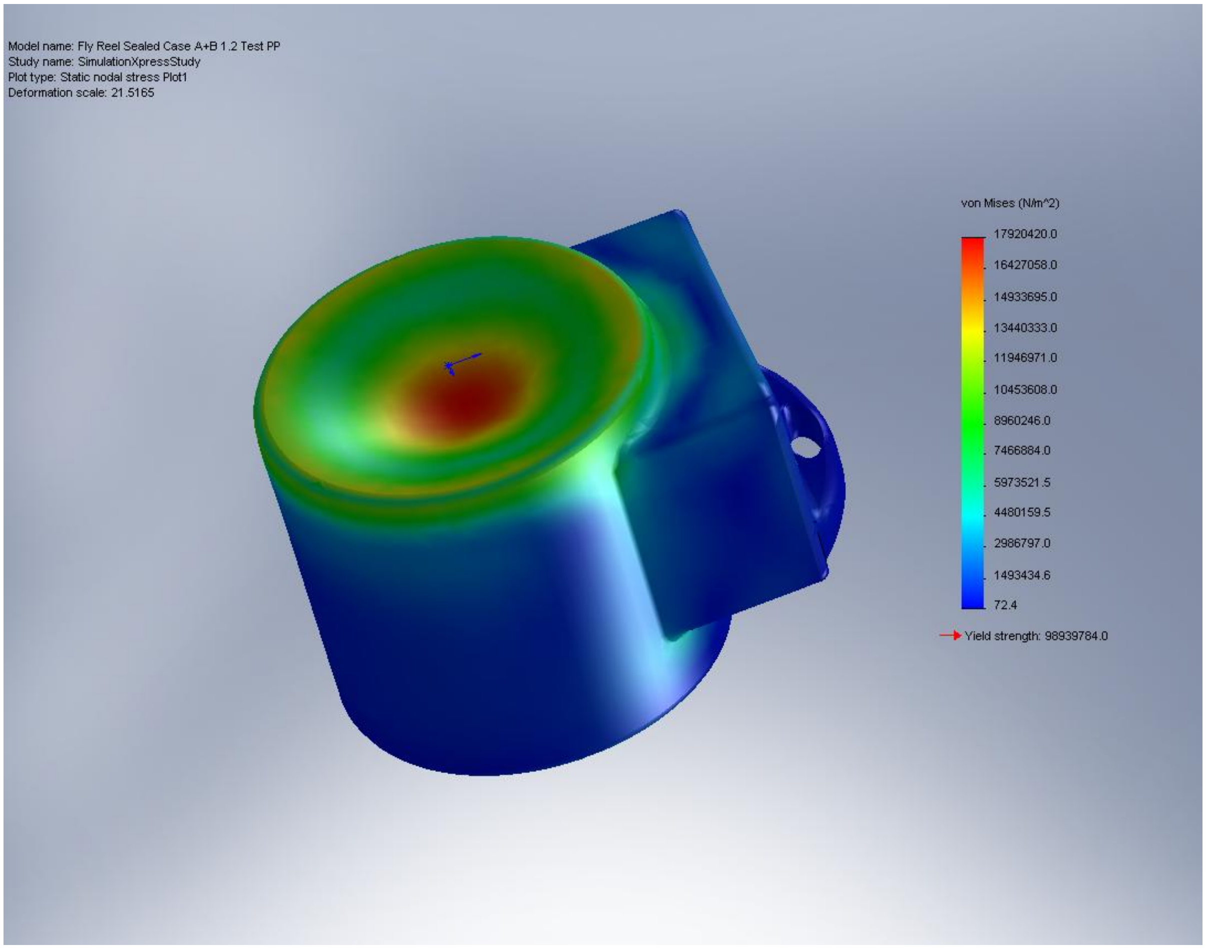
Solver Information	
Quality:	High
Solver Type:	Automatic

5. Results

5a. Stress

Name	Type	Min	Location	Max	Location
Plot1	VON: von Mises Stress	72.3666 N/m^2	(0.518104 in, -0.699983 in, -3.9375 in)	1.79204e+007 N/m^2	(-0.0324904 in, 0.00991124 in, -0.586448 in)

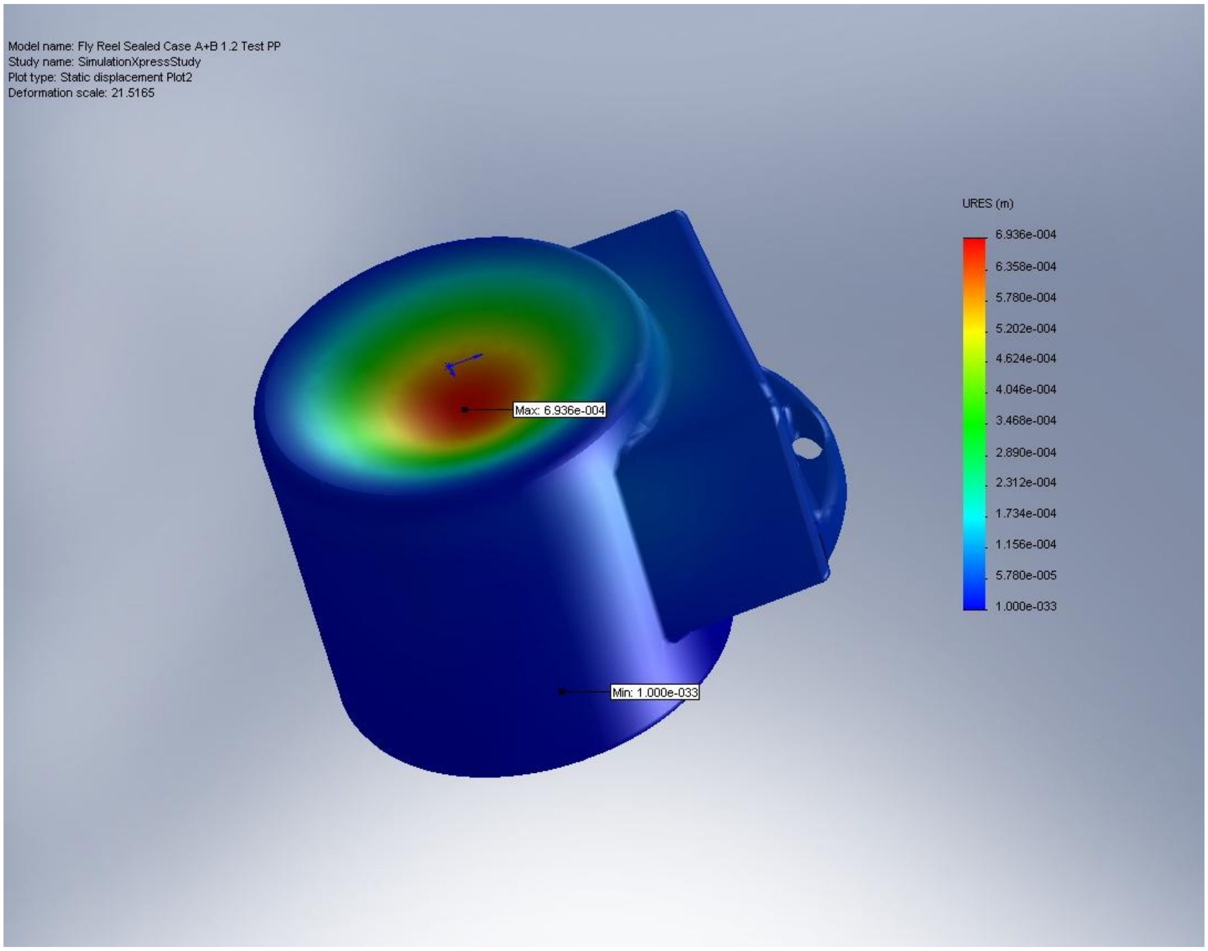
Fly Reel Sealed Case A+B 1.2 Test PP-SimulationXpressStudy-Stress-Plot1



5b. Displacement

Name	Type	Min	Location	Max	Location
Plot2	URES: Resultant Displacement	0 m	(-1.03125 in, 1.78618 in, -4 in)	0.000693617 m	(-0.0334302 in, 0.0089264 in, -0.65 in)

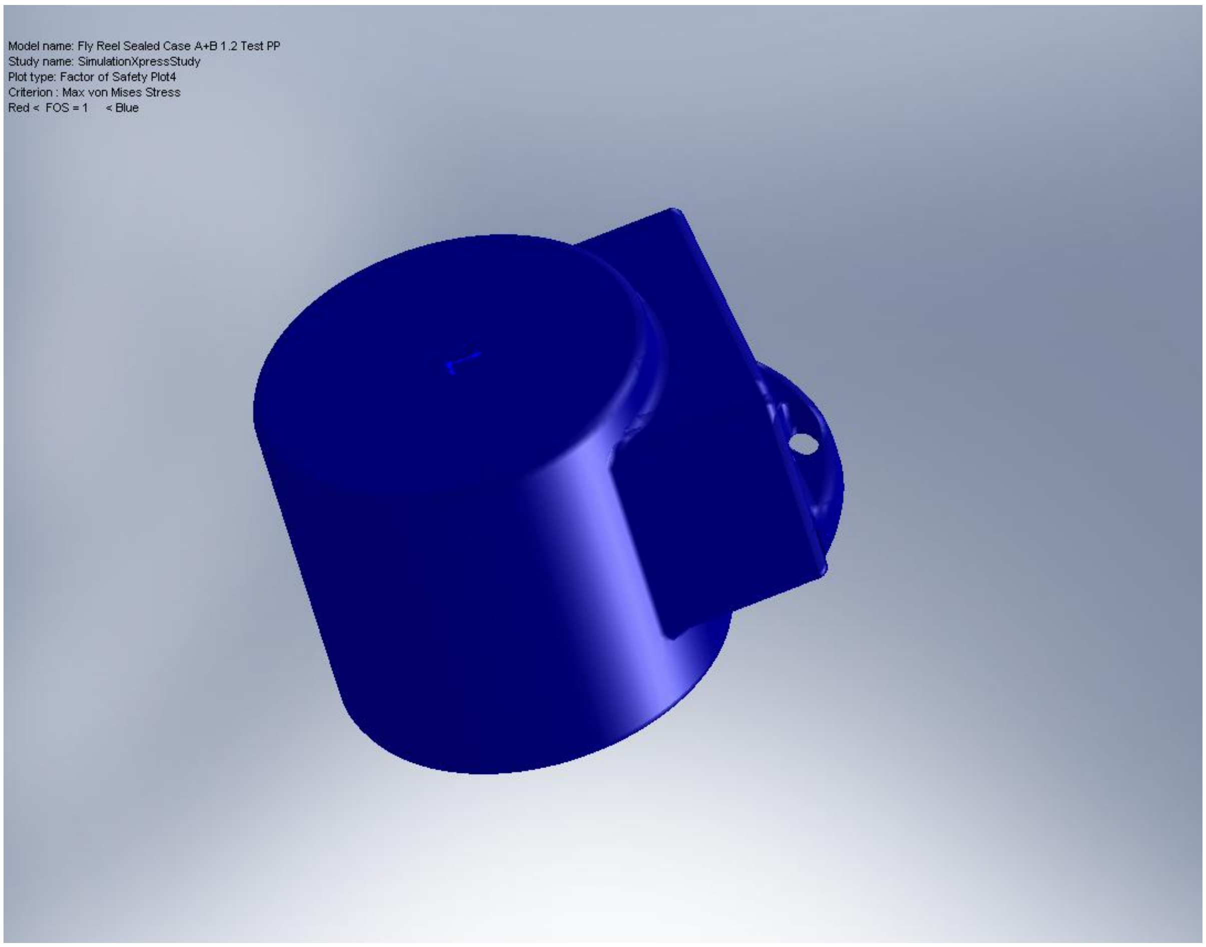
Fly Reel Sealed Case A+B 1.2 Test PP-SimulationXpressStudy-Displacement-Plot2



5c. Displacement

5d. Factor of Safety

Fly Reel Sealed Case A+B 1.2 Test PP-SimulationXpressStudy-Factor of Safety-Plot4



6. Appendix

Material name:	[SW]PP (40% long glass fiber)
Description:	
Material Source:	
Material Model Type:	Linear Elastic Isotropic
Default Failure Criterion:	Max von Mises Stress
Application Data:	

Property Name	Value	Units
Elastic modulus	8.4806e+009	N/m^2
Poisson's ratio	0.3525	NA
Mass density	1212.4	kg/m^3
Yield strength	9.894e+007	N/m^2

Note:

SolidWorks SimulationXpress design analysis results are based on linear static analysis and the material is assumed isotropic. Linear static analysis assumes that: 1) the material behavior is linear complying with Hooke's law, 2) induced displacements are adequately small to ignore changes in stiffness due to loading, and 3) loads are applied slowly in order to ignore dynamic effects.

Do not base your design decisions solely on the data presented in this report. Use this information in conjunction with experimental data and practical experience. Field testing is mandatory to validate your final design. SolidWorks SimulationXpress helps you reduce your time-to-market by reducing but not eliminating field tests.